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Relativistic fluid dynamics of multiple conserved charges

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The strongly interacting matter created in high-energy heavy-ion collisions contains a multitude of conserved quantum charges, like the baryon number, strangeness, and electric charge. These conserved charges and their currents are generally coupled to each other, e.g. a baryon diffusion current also implies a current in electric charge.
In this talk, we present a novel derivation of second-order relativistic dissipative fluid dynamics from the Boltzmann equation for multicomponent reactive mixtures with N_{spec} particle species and with N_q conserved charges. In the single-fluid approximation there are $4 + N_q$ conservation laws for multiple conserved quantum charges and for the total energy-momentum. The second-order equations of motion are derived in the $10 + 4N_q$-moment approximation for the dissipative quantities to provide closure to the conservation equations. This derivation also delivers explicit expressions for the transport coefficients of the theory. The resulting transport coefficients, such as bulk viscosity, multiple charge-diffusion and shear-viscosity coefficients are also calculated in the ultrarelativsitic limit. We will show and discuss the coupled-charge transport, the resulting separation of charge, and the implied baryon-electric or baryon-strangeness correlations in heavy-ion collisions, and argue that such effects may be relevant for programs at the future FAIR and NICA facilities, or for the discussion of the recent isobar run at RHIC.

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